North Carolina Agricultural and Technical State University

USDA NIFA

INTRODUCTION TO HEMP: AGRONOMICS AND SOIL HEALTH BENEFITS

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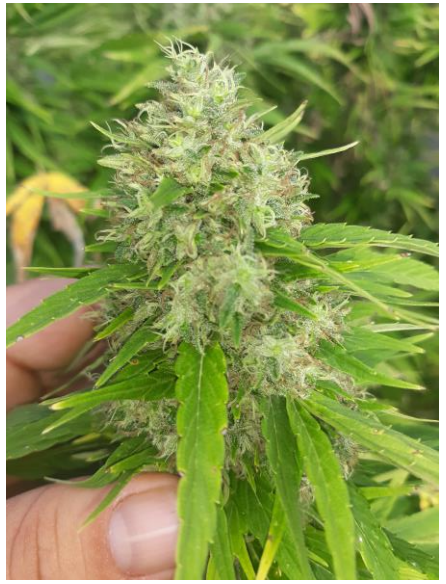
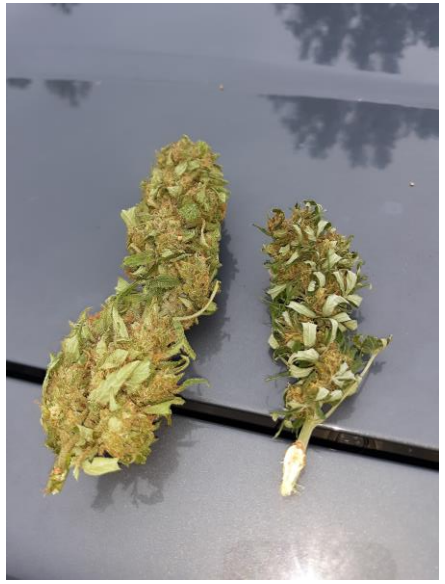
Background

- Hemp differs from its cousin marijuana on the basis of THC (0.3%)
- Hemp plants are used to produce seeds, fiber, and cannabinoids (CBD)
- After legalization there has been an emerging market for CBD hemp that has medicinal properties
- Not much information available on agronomic practices (e.g. N fertilizer requirements, harvest etc.)





Source: John Ivey, Research Technician

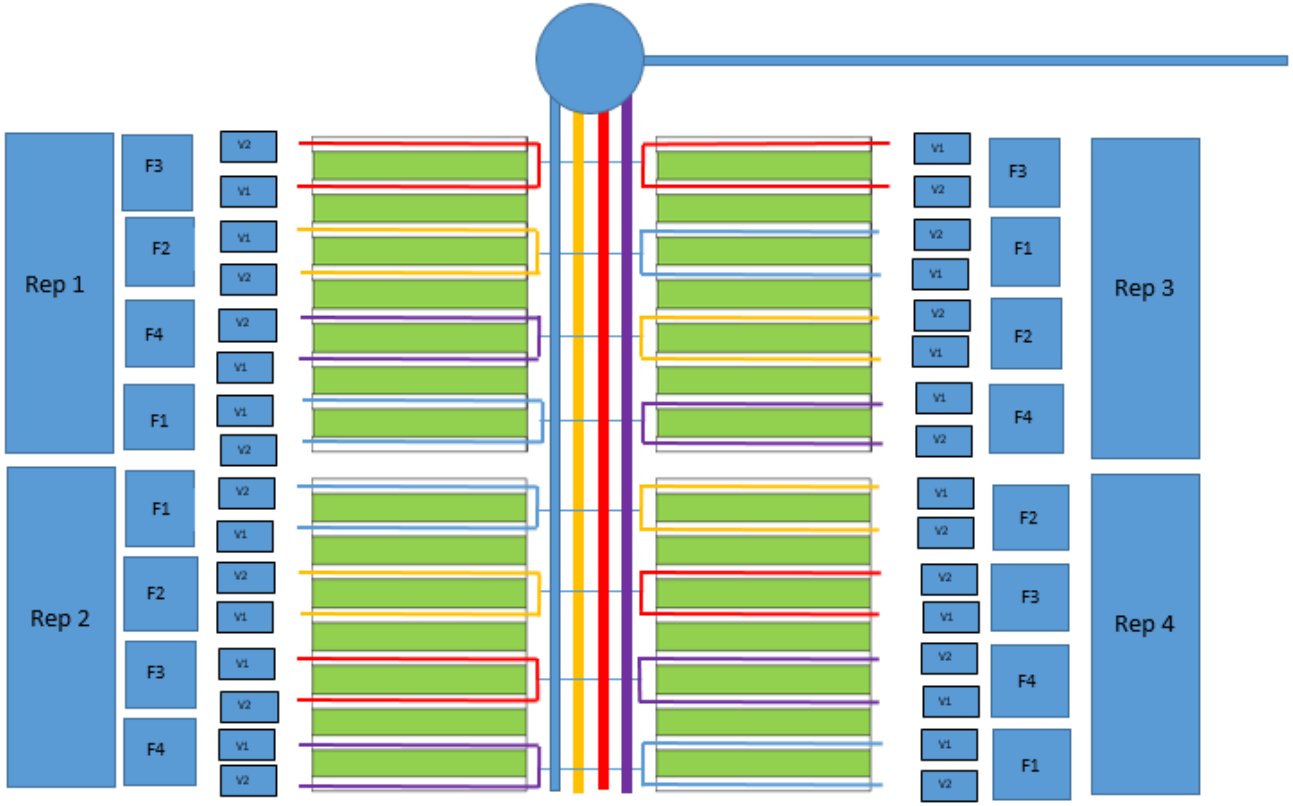
Research Objective

To determine the effect of harvesting time and different nitrogen (N) fertilizer rates on 2 hemp varieties.

Measurements presented in this talk:
1) cannabinoids (CBD and THC) concentrations, 2) yield

Treatments

1) **Varieties:** Therapy and Spectrum
2) **Fertilizer rates**:
   0 (F1), 50 (F2), 100 (F3) and 200 (F4) lbs N ac^{-1}



Randomized complete block design with 4 replicates in the field at NCA&T research farm on 1/3rd of an acre

Hemp Planting and Fertilization

Transplanted in early June, cutting were used for Spectrum and Therapy

Slow release fertilizers (12-0-0) and (5-4-3) were applied pre-plant

Source: John Ivey, Research Technician

Hemp plants in the field during July

Hemp plants from August

Pictures from the September (pre-harvest)

HARVEST (drying and bucking)

Hemp and soil health benefits

- Hemp has tremendous potential to **build soil health**
- Hemp cropping system is suitable for crop rotations, cover cropping and organic amendment (composted manure) incorporations
- Hemp also has significant **environmental benefits**:

    1. Remediation of contaminated soil through phytoremediation
    2. Biosequestration of atmospheric CO_2 to biomass
    3. Hemp biomass residue management (biochar, bioenergy etc.)

- Hemp's high planting density, rapid soil surface coverage ability and fast growth (especially the fiber yielding) varieties after emergence render it very competitive against weeds
- Crop rotations with soybean or alfalfa could prove to be beneficial for hemp
- Deep root system of hemp (fiber varieties) improve soil structure and feeds the soil
- Introducing cover crops in a hemp crop rotation would be beneficial (hemp as a cover crop might be challenging as certain varieties are highly photosensitive……..)
- e.g. Rye+crimson clover (grass-legume) cover crop mix could add nitrogen to the soil for hemp grown in summer and provide biomass to be incorporated to soil.

Organic amendments to supplement chemical fertilization in hemp

- Replacing chemical fertilizers with on-farm or off-farm organic amendments (e.g. crop residues, manure, compost etc.) can farmers' input costs and improve nutrient use efficiency, provide soil health and environmental benefits

- Application of composted manure, use of organic mulches (chopped leaves, straw, grass clippings, compost, wood chips, shredded bark, sawdust, pine needles, etc.)

- Hemp residues returned to the soil act as mulch and improve soil nutrient release/storage and also greenhouse gas emissions

Environmental benefits of growing hemp

Phytoremediation:

- Hemp is recognized as one of the plants that could be used for land reclamation
- Hemp roots (fiber) grow deep into the soil about 45–90 cm and increase the efficiency of removing widespread contamination as compared to other plants with a shallow root system.
- Hemp has a high potential to absorb and accumulate heavy metals like lead (Pb), nickel (Ni), cadmium (Cd), etc., through its roots and then store them, thus, making it possible to harvest the hemp plant alongside the hazardous compounds.

Biomass and bioenergy:

- Hemp has been recognized as one of the energy plants due to its high biomass and energy concentration per hectare.
- Weed suppressing abilities, low pesticide requirements, and soil health improvement properties of hemp plants make it even more energy efficient
- Fuel properties of hemp are either similar or superior to other solid biofuels such as cereal straw, wood, etc.
- Hemp biomass could also be transformed into biogas and ethanol therefore it has the potential to contribute toward renewable energy.

Bio-sequestration:

- Hemp's fast growth and development makes it one of the fastest sources of CO_2-to-biomass converter.
- Hemp has been proven to be an ideal carbon sink as it can capture more CO_2 per hectare than other commercial crops or even forests. For example, one hectare of hemp can absorb 22 tons of CO_2 per hectare.
- High biomass crops like hemp, that are grown for fiber, can sequester higher amounts of carbon by photosynthesis and then store it in the plant's body and roots through bio-sequestration.
- One of the other potential uses of hemp biomass would be the production of biochar for soil applications that could potentially improve soil carbon sequestration and nutrient retention

Hemp biochar vs hardwood biochar: Impacts on soil health

- Hemp residue had the greatest impact on soil microbial activity as compared to hardwood biochar.
- Both hemp biochar and hemp residue had positive influence on the soil enzyme and type of soil microorganisms
- Applying hemp biochar tended to increase the soil microbial activity compared with hardwood biochar.
- Soil type greatly influenced the effect of hemp residues on soil health indicators

Adesina *et al* (in prep)

Some practical points to consider:

- Hemp genetics play a pivotal role in determining CBD, THC levels, flowering time, terpene profile (taste and smell) etc.
- When planting hemp, it is advised to split fertilizer requirements into 2-3 applications- preplant, once during vegetative growth and once at the onset of the flowering period
- Plant spacing is determined by planting date- for June planting 6ft on center is what we praticed
- Weed control should be considered in the rows and row middles. Plasticulture and cultivation are the most popular methods for controlling weeds in the rows. Mowing and tilling (rototilling) are the most effective ways of controlling weeds in row middles.
- CBD hemp has high risk for getting cross pollinated especially if seed or fiber varieties are in close proximity
- Harvest is the most labor intensive task of the season and anyone growing should consider about drying/curing space
- Make sure you have a post-harvest plan- sell, process or consume personally

agriculture

MDPI

Review

A Review on the Current State of Knowledge of Growing Conditions, Agronomic Soil Health Practices and Utilities of Hemp in the United States

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Thank you, Aggie Pride!

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A&T Industrial Hemp Page- https://www.ncat.edu/caes/hemp-program/